

Claims:

1. A friction stir-spot welding method comprising inserting a welding tool having a symmetry with respect to a shaft into a portion of a member to be welded, while rotating under a pressure,
5 thereby to heat and soften the member in the neighborhood of the welding tool by friction heat so as to integrate the member at a welding portion, characterized in that a rotation shaft of the welding tool is tilted in the state that the welding tool is inserted into the member and the tip portion of the welding
10 tool is moved.
2. The friction stir-spot welding according to claim 1, characterized in that the welding tool being symmetry with respect to a shaft has no pin that protrudes from the tip.
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3. The friction stir-spot welding according to claim 1, characterized in that the welding tool being symmetry with respect to a shaft has a pin that protrudes from the tip.
- 20 4. The friction stir-spot welding according to claim 1, characterized in that the welding tool is inserted into stacked metallic members from an upper direction thereof; and the tip portion of the welding tool is moved in the horizontal direction while the rotation shaft of the welding tool is tilted under
25 the state that the welding tool is inserted into the members.

5. The friction stir-spot welding according to claim 1, characterized in that the rotation shaft of the welding tool is tilted around one point in the direction of the rotation shaft as a fulcrum, thereby moving the tip portion of the welding tool.

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6. A friction stir-spot welding apparatus for inserting a welding tool being a symmetry with respect to a shaft, while rotating under a pressure into a portion of a member to be welded, thereby to heat and soften the member in the neighborhood of the welding tool by friction heat so as to integrate the member at a welding portion, characterized in that the device comprises:

a driving device for driving the welding tool in the direction of the rotation shaft thereof; and

15 a rotation shaft conversion device for converting the rotation shaft of the welding tool.

7. The friction stir-spot welding apparatus according to claim 6, characterized in that the welding tool driving device comprises a welding head up-and-down moving motor for moving a welding head for holding the welding tool in the direction of the rotation shaft of the welding tool; a belt for transferring the rotation force of the motor to a ball spring; and a guide support for guiding the welding head that moves in accordance with the rotation of the ball spring.

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8. The friction stir-spot welding apparatus according to claim 6, characterized in that the welding tool rotation shaft conversion device comprises a hummer one end of which is connected to a welding head swing shaft having one point in the direction of the rotation shaft of the welding tool as a fulcrum; and a stopper to which the other end of the hummer collides when the welding head comes down, wherein the tip portion of the welding tool held by the welding head swings around the welding head swing shaft as the fulcrum when the hummer further comes down from the state where the hummer collides the stopper.

9. The friction stir-spot welding apparatus according to claim 6, characterized in that the welding tool rotation shaft conversion device comprises an air cylinder, a rod that moves by stretch and shrink by the air cylinder, and an arm one end of which is connected to the welding head swing shaft having one point in the direction of the rotation shaft of the welding tool as a fulcrum, wherein the rotation shaft of the welding tool is tilted around the welding head swing shaft as the fulcrum held by the welding head as the rod moves.

10. The friction stir-spot welding apparatus according to claim 6, wherein the welding apparatus is disposed at the tip of the robot arm.

11. A friction stir-spot welding apparatus a welding tool having a structure of axis symmetry, a welding head having a welding tool rotation device for holding the welding tool and for rotating the welding tool around its shaft and a welding head driving device for moving the welding head in the direction of the rotation shaft of the welding tool, characterized in that the welding apparatus is provided with a welding tool rotation shaft conversion device for tilting the rotation shaft of the welding tool around one point in the direction of the rotation shaft of the welding tool as a fulcrum.

12. The friction stir-spot welding apparatus according to claim 11, characterized in that the welding head is so constituted as to move in the direction of the rotation of the welding tool by the guide support, the guide support being provided with a stopper that catches the state that the welding tool is inserted into the member to be welded by a predetermined depth, and wherein the tip portion of the welding head swings around one point in the direction of the rotation shaft of the welding tool as a fulcrum when the welding head is further inserted into the member from the state that the welding head touches the stopper.

13. The friction stir-spot welding apparatus according to claim 11, characterized in that the welding apparatus is provided with an arm one end of which is connected to a welding head swing

shaft having one point in the direction of the rotation shaft
of the welding tool as a fulcrum, a rod one end of which is
connected to the other end of the arm, and a cylinder that
stretches and shrinks the rod, wherein the welding head for
5 holding the welding tool rotates around the welding head swing
shaft as the fulcrum, a welding tool rotation shaft is tilted
when the cylinder moves the arm.

14. The friction stir-spot welding apparatus according to claim
10 11, wherein the welding apparatus is disposed at the tip of the
robot arm.